



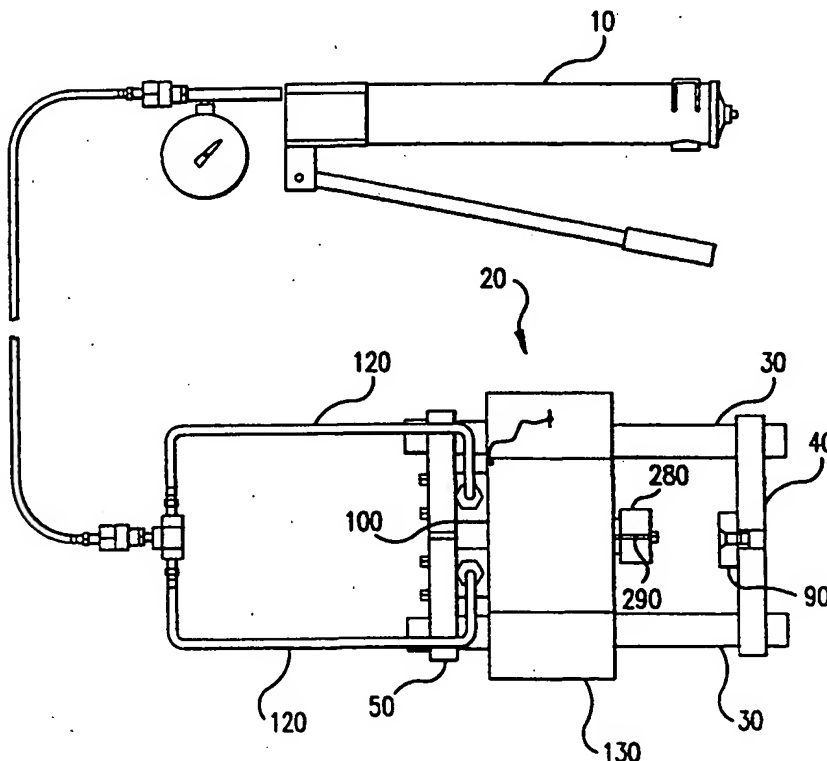
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>B23P 19/02</b>	<b>A1</b>	(11) International Publication Number: <b>WO 98/15381</b> (43) International Publication Date: 16 April 1998 (16.04.98)
(21) International Application Number: PCT/US97/18119 (22) International Filing Date: 8 October 1997 (08.10.97) (30) Priority Data: 08/728,648                      10 October 1996 (10.10.96)                      US (71) Applicant: TYCO SUBMARINE SYSTEMS LTD. [US/US]; 101 Crawfords Corner Road, Holmdel, NJ 07723 (US). (72) Inventor: AMIRKALALI, Mohamad, A.; Unit #3, 57 Bridge- water Drive, Oceanport, NJ 07757 (US). (74) Agents: PIETRANTONIO, Frank et al.; Kenyon & Kenyon, 1025 Connecticut Avenue, N.W., Washington, DC 20036 (US).	(81) Designated States: AU, CA, JP, KR, MX, NZ, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the          claims and to be republished in the event of the receipt of          amendments.</i>	

(54) Title: PRESS APPARATUS FOR FIBER-OPTIC PLUG

## (57) Abstract

A press apparatus (20) for pressing plugs onto fiber optic cables in a terminating socket includes a planar, rectangular frame comprised of two parallel posts (30) slidably engaged with two parallel endplates (40, 50). Split-rings (34) fitted on the posts (30) prevent the endplates (40, 50) from slipping off the posts (30) and permit easy assembly and disassembly of the frame. The press apparatus further comprises a socket guide (90) attached to the inner surface of one endplate (40). Attached to the inner surface (110) of the other endplate (50) are hydraulic cylinders (100) which connect to a force plate (140) that supports a plunger (190) in alignment with the central axis of the socket guide (90). A pump (10) supplies pressure to the hydraulic cylinders (100) and forces the plunger (190) towards the socket guide (90).



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## PRESS APPARATUS FOR FIBER-OPTIC PLUG

Field of the Invention

5           The present invention relates to the field of submarine fiber-optic communications systems and, in particular, to an apparatus for connecting fiber optic cables to terminating sockets for use in a cable joint assembly.

Background of the Invention

10           In our truly global society, more and more people are becoming interconnected with one another through telecommunications systems. Although submarine fiber-optic cable communications systems are but one type of telecommunication system, submarine fiber-optic cables are capable of carrying a greater number of data and voice transmissions than traditional submarine cable systems or modern satellite communication systems.

15           Stretching thousands of miles across the oceans, submarine fiber-optic cables lie on the ocean's floor, thousands of feet below sea level. Because no one cable could be made that extended thousands of miles in length, submarine fiber-optic cable communication systems are comprised of a series

of submarine fiber-optic cables that are spliced together at cable joints. In this manner, many individual cables can be connected to form a single cable of the required length.

5 If one were to cut open a standard "non-armored" fiber-optic cable, he would see that each cable is comprised of a series of optic fibers clustered around a steel "king" wire. Together, these wires form the fiber-optic "core" of the cable. The fiber-optic core itself is surrounded by steel strength members and two watertight, insulating jackets (an inner copper jacket and an outer polyethylene jacket) encase the entire assembly. The function of the optic  
10 fibers is to carry the data and voice transmissions sent over the fiber-optic cable; the steel wires carry any loads placed upon the cable and, in conjunction with the insulating jackets, give the cable its rigidity.

A cable joint is used to connect two cables. Traditionally, cable joints were formed by "terminating" the two cables in separate terminating sockets  
15 and connecting the two terminating sockets with a load-bearing fiber storage tray or cylinder. The individual optic fibers of the cables were then spliced together and secured in the storage tray and the entire subassembly was then covered with a steel jacket and "insulated" to keep it waterproof.

Cable terminating technology is well-known in the prior art. The idea  
20 behind cable terminating is to secure the load-bearing steel members of the fiber optic cable, including both the steel strength members and the steel king wire, to a terminating socket so that any load placed upon the steel members would be transferred to the terminating socket. The fragile optic fibers of the cable, however, would completely pass through the terminating socket.

Typically the steel strength members are terminated by stripping off the cable's protective insulation, separating the strength members from the fiber-optic core, and slipping the steel members and the core through the center of the terminating socket. A copper jacket and a steel plug are then placed over the fiber-optic core and the steel plug is firmly wedged into the terminating socket. In this way, the steel strength members are secured against the interior surface of the terminating socket, while the fiber-optic core passes freely through the socket. The steel plug is generally wedged into the terminating socket using a press. However, existing presses are usually constructed as a single unit wherein the endplates are stabilized by external bracing because the endplates are not planar with the supporting frame or guide posts. Such presses are difficult to transport and cannot be easily assembled or disassembled, a feature which is particularly important if the press is to be used on a ship.

#### 15    Summary of the Invention

The present invention is a press apparatus for securely inserting and wedging a plug into a terminating socket to grip the steel wires surrounding a fiber optic core of a fiber optic cable. The press apparatus includes a planar, rectangular frame including opposing endplates slidably engaging parallel posts. A first endplate has a socket guide to receive a terminating socket. A second endplate has a plunger supported on a force plate which is interconnected to the second endplate by hydraulic cylinders. When the hydraulic cylinders are pressurized, the plunger is advanced towards the socket guide to force a plug into a terminating socket positioned in the socket guide. Split rings fitted into recessed channels of the posts permit the frame

to be easily assembled and disassembled. And, when the frame is assembled, the split rings prevent the end plates from being forced off the posts during use.

#### Brief Description of the Drawings

- 5        **FIG. 1** is a top view of a press apparatus according to the preferred embodiment of the invention.
- FIG. 2** is a top cut-away view of the press apparatus of **FIG. 1**.
- FIG. 3** is a side view of a post.
- FIG. 4** is a top view of a split ring.
- 10       **FIG. 5** is a view of the inner surface of a first endplate.
- FIG. 6** is a view of the inner surface of a second endplate.
- FIG. 7** is a front view of a force plate.
- FIG. 8** is a side view of a plunger.
- FIG. 9** is an end view of a cover assembly.

#### 15       Detailed Description of the Invention

         The present invention is a press apparatus for use with fiber-optic cables and terminating sockets. As seen in Figs. 1-4, a hand pump **10** is releasably connected to press apparatus **20**. The press apparatus includes two substantially identical posts **30**. Each post has a recessed, radial

20       channel **32** formed near each end of the post **30**. A split ring **34**, comprised of two mirror image sections **35**, is fitted in each recessed channel **32**, the outer diameter of the split ring **34** being larger than the outer diameter of the post **30**.

         Referring to FIGs. 2, 5 and 6, the ends of each post **30** are slidably

25       engaged through holes **36** in a first endplate **40** and a second endplate **50**.

On the outer surface of the endplates 40, 50, larger recessed holes 38 are adapted to receive the split rings 34 fitted on the posts 30. Thus, the endplates 40, 50 are free to slide along the posts 30 until the recessed holes 38 abut the split rings 34. The posts 30 and endplates 40, 50 are arranged in a plane to form a stable, rectangular frame. The interior surface 60 of the first endplate 40 has slot 70 extending from a top edge 80 of the endplate 40 to the center of a recessed hole 85 formed on the interior surface 60 of the first endplate 40. The recessed hole 85 is adapted to receive a socket guide 90 which is releasably secured in the recessed hole 85.

10       The second endplate 50 has two hydraulic cylinders 100 releasably attached at one end within recessed holes 102 in the interior surface 110 of the second endplate 50. As shown in FIG. 1, operatively attached to a side of each hydraulic cylinder is a hydraulic line 120 which leads to the hydraulic hand pump 10. A cover assembly 130, shown in FIGs. 1, 2 and 9 is slidably engaged on the two posts 30. The cover assembly 130 has a stepped top surface 132 which provides clearance for internal components of the press apparatus 20. A first longitudinal edge 134 and a second longitudinal edge 136 of the cover assembly 130 are curved to slidably engage the posts 30. The first longitudinal edge 134 extends further from the center of the stepped top surface 132 than the second longitudinal edge 136. This additional extension permits the cover assembly 130 to be easily attached to the posts 30 when the posts 30 are engaged in the endplates 40, 50. Once the cover assembly 130 is positioned on the posts 30, a removable pin 137 extending through the edges of the second longitudinal edge 136 keeps the stepped top surface 132 properly centered between the posts 30. To remove the cover assembly 130, the pin 137 is removed and the cover assembly 130 is slid of

the posts 30. To prevent loss of the pin 137, it may be attached by a flexible chain 138 to a surface of the cover assembly 130.

Referring to FIGs. 2 and 7, a force plate 140 is releasably attached to the other end of each of the hydraulic cylinders 100. A slot 150 extends from  
5 a top edge 160 of the force plate 140 to the center of a recessed hole 170 formed on the interior surface 180 of the force plate 140. The recessed hole 170 is adapted to receive a plunger 190 which is releasably secured in the recessed hole 170.

Referring to FIGs. 2 and 8, the plunger 190 has a longitudinal slot 200  
10 which extends to a cylindrical passageway 210 in the center of the plunger 190. The plunger 190 has a cylindrical central section 220, an inwardly tapered nose section 230, and a base 240 having a larger radius than the central section 220. The cylindrical passageway 210 connects to a larger diameter cylindrical recess 250 in the nose section 230. Holes 260 extend  
15 through the base 240 of the plunger 190 to permit the plunger 190 to be attached to the force plate 140 by screws or bolts 270.

As shown in FIGs. 1 and 2, a plunger guide 280 is slidably fit over the plunger 190 such that one end of the plunger guide 280 rests against the base 240 of the plunger 190. The plunger guide 280 has a longitudinal slot  
20 290 which extends from the outer surface of the plunger guide 280 to the center of the axial passageway 300 in the plunger guide 280. The other end of the plunger guide 280 has an enlarged diameter section 310 which includes a recessed hole 320 which is sized to receive a terminal socket (not shown). When the press apparatus 20 is properly assembled, the  
25 longitudinal slots 70, 150, 200 and 290 are axially aligned so that a desired



length of fiber optic core extending from a terminating socket (not shown) can be laid in the aligned slots.

To operate the press apparatus 20, a terminating socket (not shown) having a extending fiber optic core is placed in the socket guide 90. The fiber  
5 optic cable has been suitably prepared by splaying the steel strength members surrounding the core and placing a tapered plug and jacket over the core, between the core and the steel strength members, in a manner that is well known by persons of ordinary skill in the art. When the terminating socket, cable, jacket and plug are properly positioned, hydraulic pressure is  
10 applied to the hydraulic cylinders 100 through the hand pump 10. As pressure is increased, the hydraulic cylinders 100 advance the plunger 190 towards the terminating socket positioned in the socket guide 90. The nose of the plunger 190 engages the plug and pushes the plug along the fiber optic core such that the plug is securely wedged in the terminating socket.  
15 When the plug insertion is completed, the plunger direction is reversed, leaving the plug wedged firmly in place.

The various components of the press apparatus 20 are preferably made of stainless steel. However, any other material may be used as long as it is sufficiently strong and rigid to withstand the stresses induced by the  
20 action of the plunger 190 when the plug is wedged in the terminating socket. Although the posts 30 have been illustrated as cylindrical, they may have any convenient cross section, as long as the split rings 34 and holes in the endplates 40, 50 are correspondingly modified. For example, the posts 30 could have a square or oval cross section. Connectors for releasable  
25 components of the press apparatus may be any of a number of well known fasteners such as bolts, screws or clips.

The press apparatus 20 of the present invention is highly stable under load as a result of the planar arrangement of the posts 30 and the endplates 40, 50. In addition, the press apparatus 20 is easy to assemble and disassemble, and can be broken down into its component parts for easy  
5 transport

Still other objects and advantages of the present invention will become readily apparent to those skilled in this art from the above-recited detailed description, wherein only the preferred embodiment of the invention has been shown and described. The description of the preferred embodiment is simply  
10 by way of illustration of the best mode contemplated for carrying out the invention. As will be realized, the invention is capable of other and different embodiments, and its several details are capable of modification in various respects, all without departing from the invention. Accordingly, the drawings and descriptions are to be regarded as illustrative in nature, and not as  
15 restrictive.

What is claimed is:

- 1           1.     A press apparatus for firmly engaging a plug into a terminating  
2 socket, the press apparatus comprising:  
3           a rectangular, planar support frame including:  
4                 a)     two parallel elongated posts; and  
5                 b)     two parallel endplates disposed at right angles to the  
6 posts, wherein each of the elongated posts is slidably engaged with each of  
7 the endplates;  
8           detachable means for preventing the endplates from sliding off the  
9 posts;  
10          a socket guide attached to an inner surface of one of the endplates;  
11          a hydraulic cylinder releasably attached at one end to an opposing  
12 inner surface of the other endplate;  
13          a force plate attached to the other end of the hydraulic cylinder;  
14          a plunger releasably attached at one end to the force plate and having  
15 a nose aligned with the center axis of the socket guide;  
16          a plunger guide attached to the plunger and adapted to be capable of  
17 receiving a terminating socket; and  
18          a pump operatively connected to the hydraulic cylinder.

- 1           2.     A press apparatus for firmly engaging a plug into a terminating  
2 socket, the press apparatus comprising:  
3           two elongated posts, each of the two posts having recessed radial  
4 channels near each end of the post;  
5           four split rings, wherein each split ring is fitted together around a  
6 corresponding radial channel;

7 a first endplate having an outer surface and an inner surface and two  
8 post holes extending through the plate, wherein each post hole slidably  
9 receives a corresponding post, the first endplate having a recessed hole on  
10 the outer surface around each of the the post holes to receive a split ring  
11 from a corresponding post;

12 a cylindrical socket guide releasably attached to the inner surface of  
13 the first endplate, the socket guide having an internal configuration capable  
14 of receiving a terminating socket;

15 a second endplate having an inner surface and an outer surface and  
16 two post holes extending through the plate, wherein each post hole slidably  
17 receives a corresponding post, the inner surface of the second endplate  
18 being in opposed relationship to the inner surface of the first endplate, the  
19 outer surface of the second endplate having a recessed hole around each of  
20 the the post holes to receive a split ring from a corresponding post, wherein  
21 the split rings prevent outward movement of the first and second endplates  
22 beyond the split rings and the posts and the first and second endplates are  
23 arranged in a plane;

24 two hydraulic cylinders, each of the cylinders being releasably  
25 attached at one end to the inner surface of the second endplate;

26 a force plate removably attached to the other end of each of the  
27 hydraulic cylinders;

28 a plunger having a nose and a base, wherein the base of the plunger  
29 is releasably attached to the force plate and the nose of the plunger is  
30 aligned with the center axis of the socket guide; and

31 a plunger guide slidably attached to the plunger and having a  
32 recessed cylindrical opening facing the socket guide, the cylindrical opening  
33 being capable of receiving a terminating socket.

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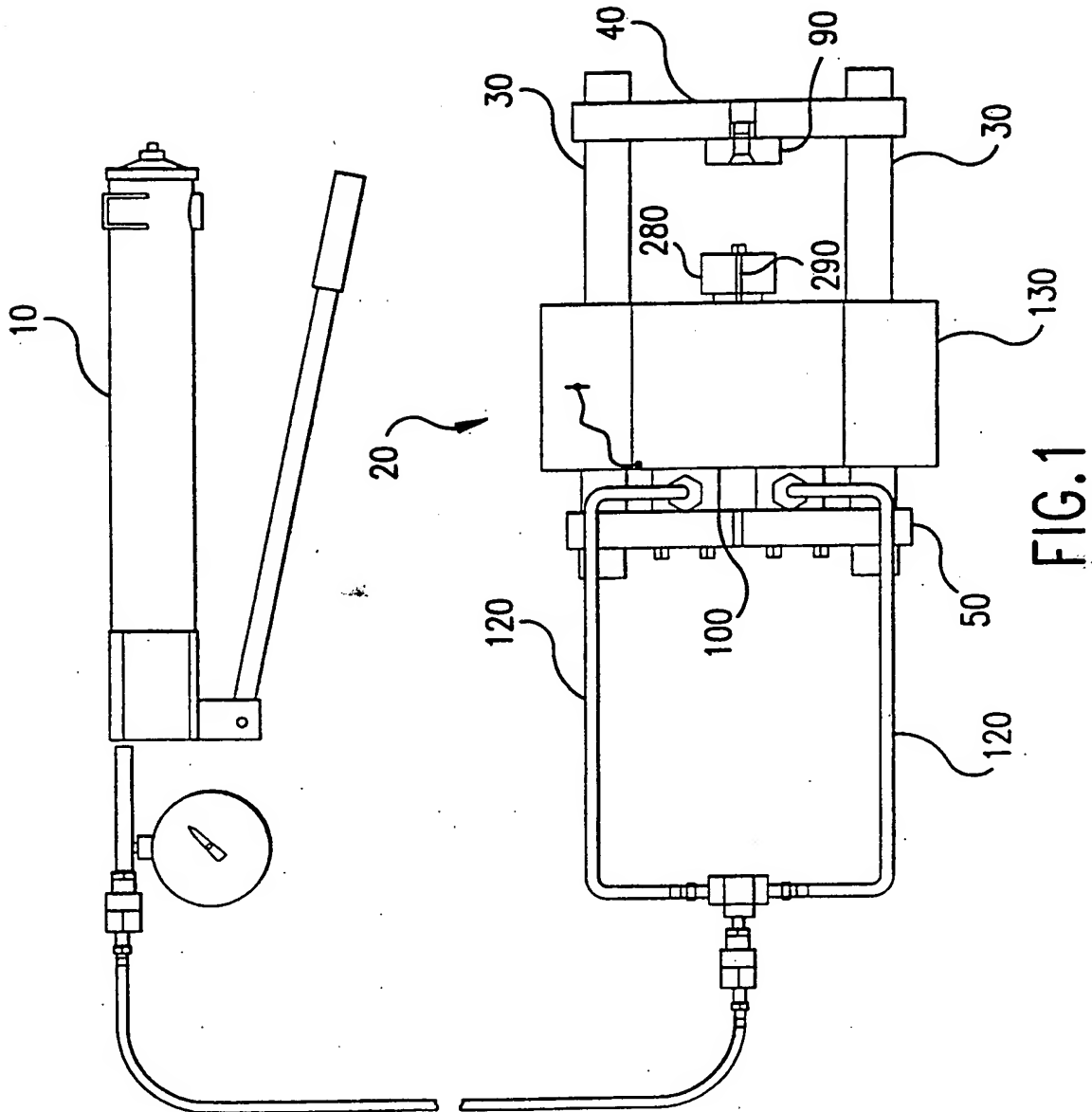
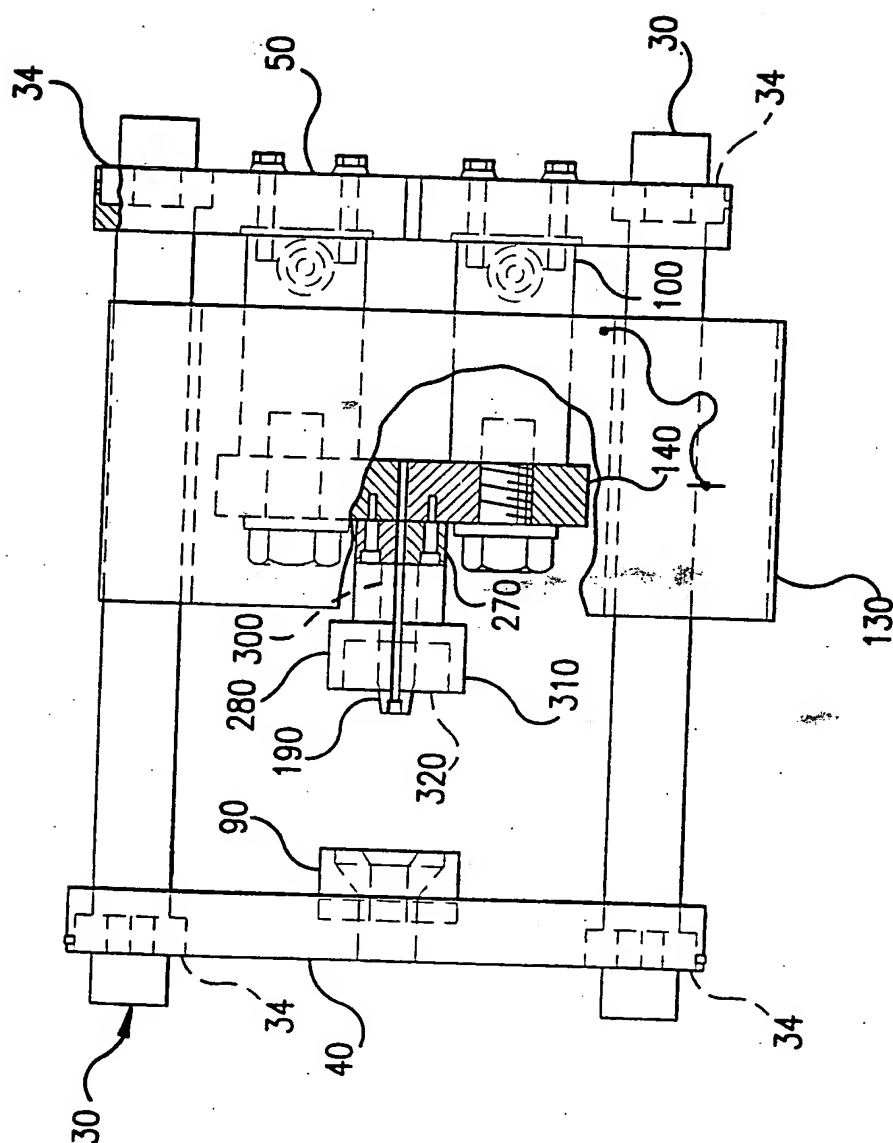


FIG. 1



**FIG. 2**

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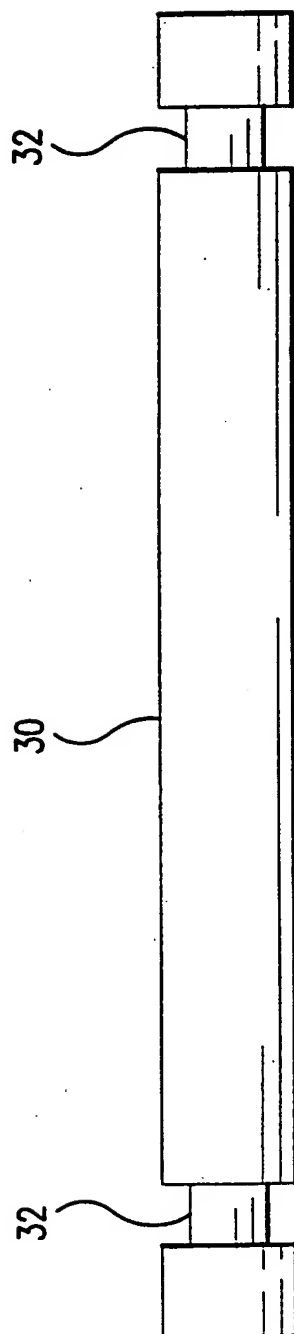


FIG. 3

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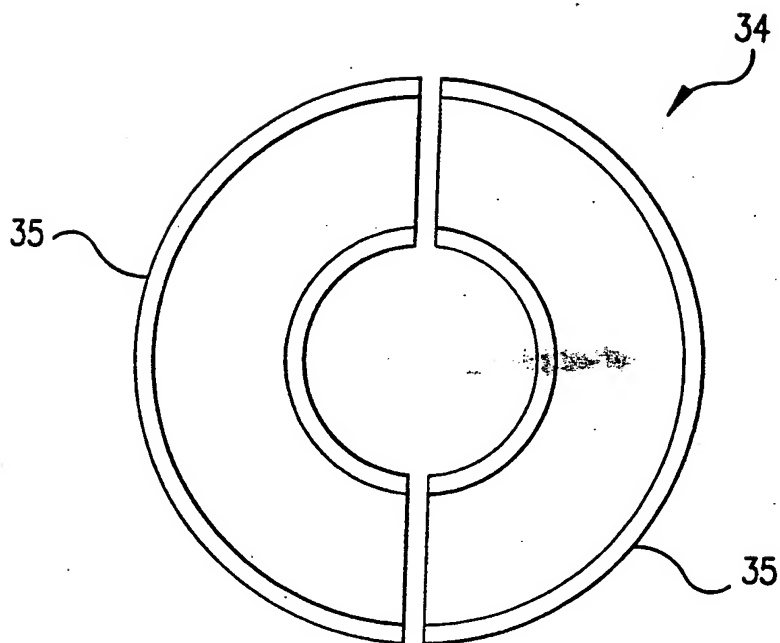


FIG. 4



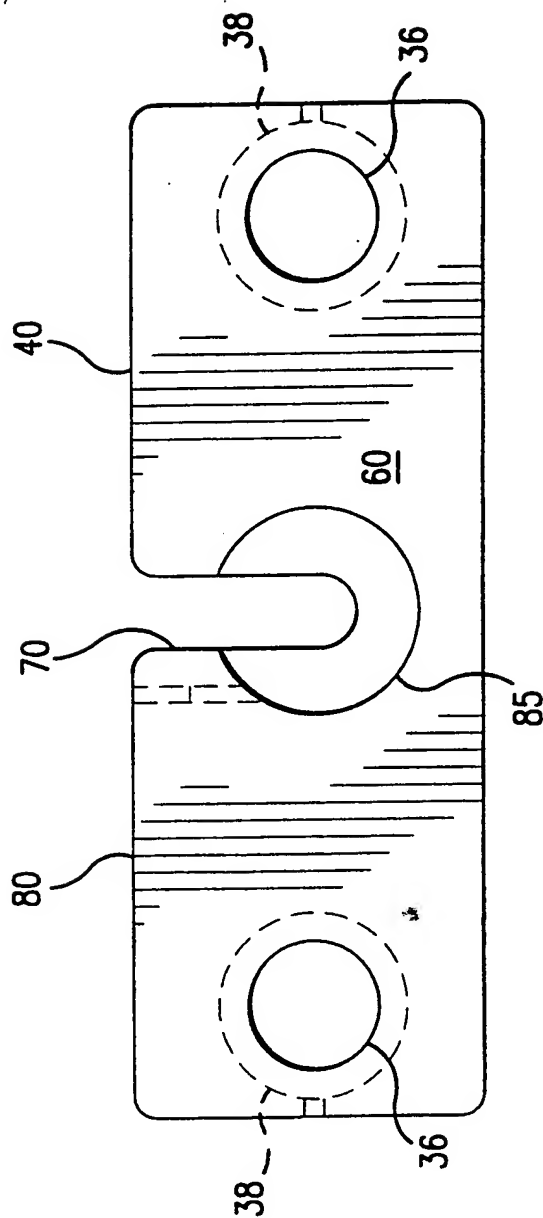


FIG. 5

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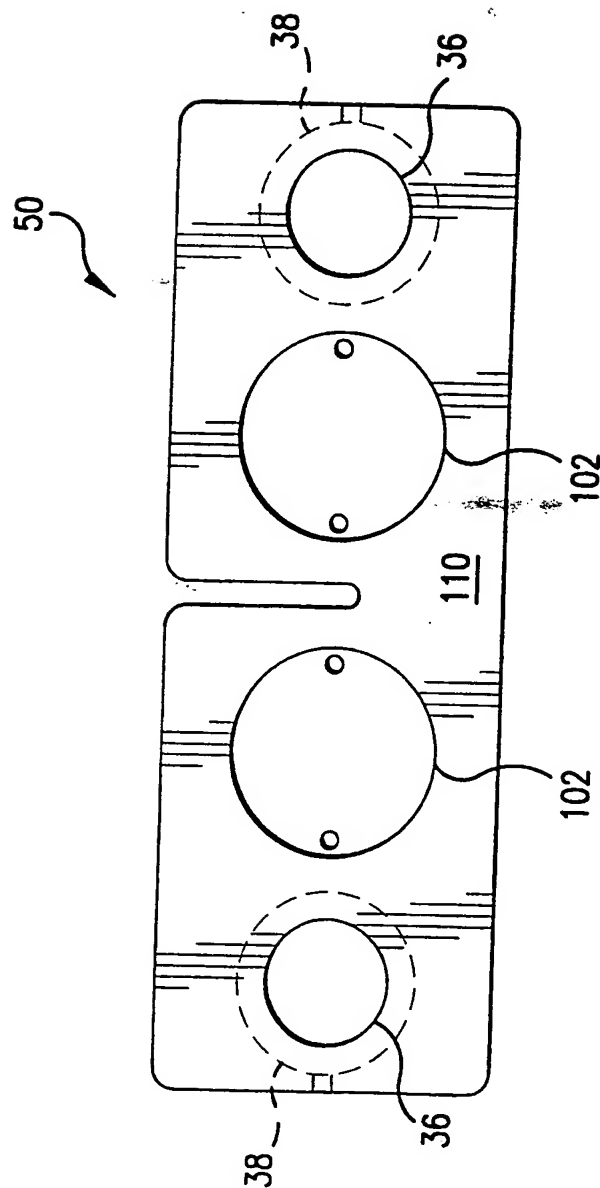


FIG. 6

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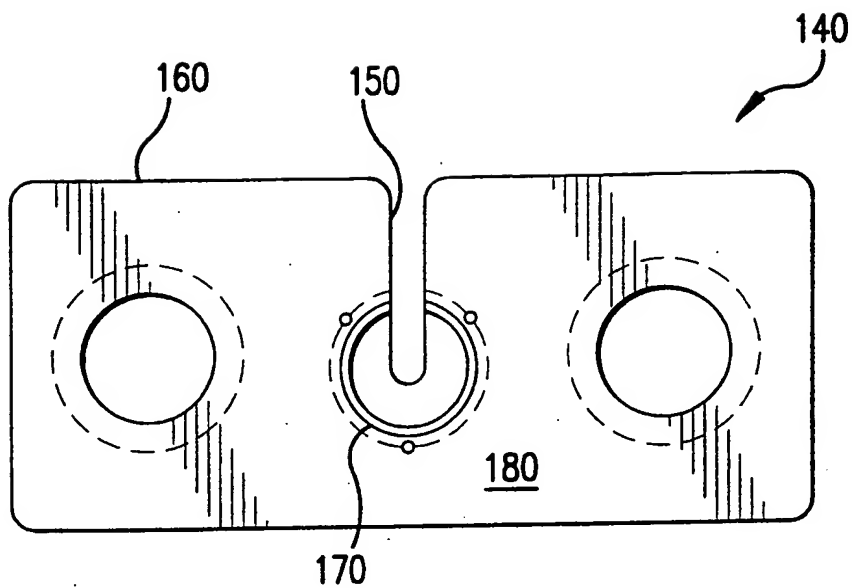


FIG. 7

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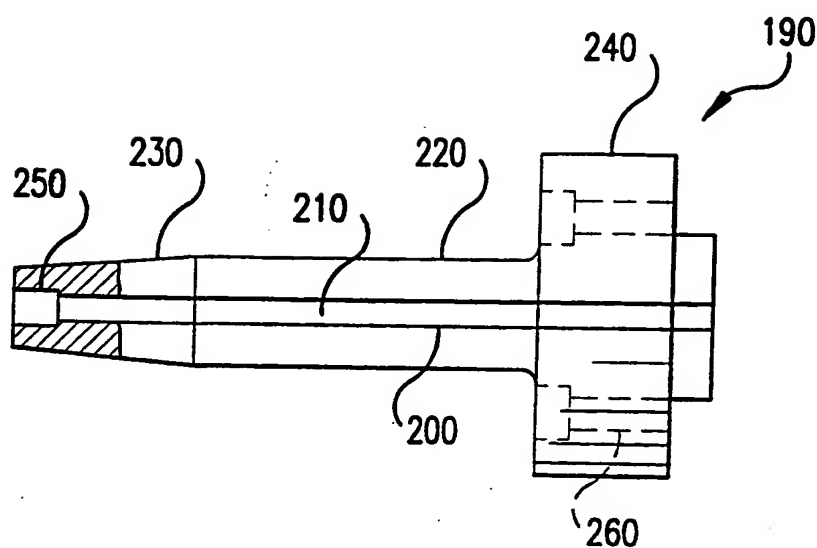


FIG. 8

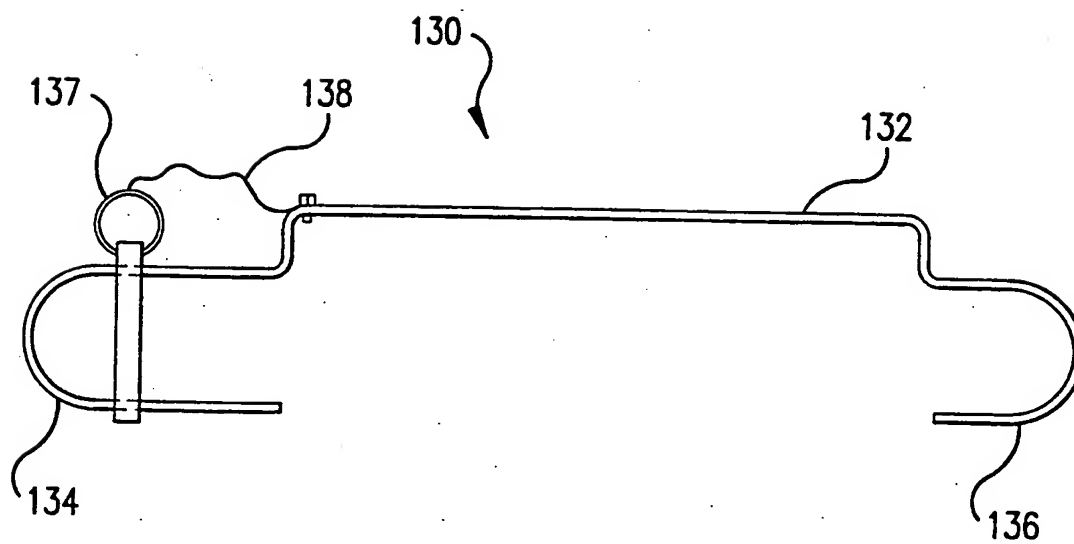


FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US97/18119

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B23P 19/02

US CL :29/251

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Minimum documentation searched (classification system followed by classification symbols)

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,283,699 A (HAWKINS) 08 NOVEMBER 1966, SEE ENTIRE DOCUMENT.	1
Y	US 4,009,867 A (DIFFENDERFER) 01 MARCH 1977, SEE ENTIRE DOCUMENT.	2
A	US 2,485,022 A (TAYLOR) 18 OCTOBER 1949, SEE ENTIRE DOCUMENT.	1-2
A	US 4,283,825 A (MCKAY ET AL.) 18 AUGUST 1981, SEE ENTIRE DOCUMENT.	1-2

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Date of the actual completion of the international search

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